

Meeting the standards during a global pandemic: a mixed methods study of FEPAC accredited forensic science educational programs

Sabra Jones, PhD^{1a}, Ronald R. Thrasher, PhD¹, B. Bavette Miler, PhD¹, James D. Hess, PhD¹, Jarrad Wagner, PhD¹

¹Oklahoma State University, Center for Health Sciences, Tulsa, OK, USA

^acorresponding author: sabra@soft-tox.org

Abstract: Introduction: Standardization is used to ensure consistency and reduce variability within a given field such as forensic education. Evaluating how Forensic Science Education Programs Accreditation Commission's (FEPAC) programs met select standards during a public health crisis may help us to understand its impact. To this end, an explanatory sequential mixed methods design employing Grounded Theory was utilized. The purpose of this study was to evaluate FEPAC accredited masters' programs and how accreditation standards were met with a focus on the effect of a global pandemic in four core areas. **Methods:** Twenty-one FEPAC masters' programs were identified. Qualtrics was used to collect data on core standards, followed by qualitative interviews to further expand on initial findings. Interview data was analyzed with ATLAS.ti to identify themes in responses to questions. Procedures and materials were approved by Oklahoma State University Institutional Review Board. **Results:** Of the 21 programs, 13 (~62%) of program directors completed the survey. Pre-pandemic, ~77% of programs offered traditional education (Core 1) with only 23% offering online courses. No programs offered online formats for more than 25% of courses. March 2020 through 2020-2021 academic year, there was variability in the number of courses offered online from 25-100% of program's coursework. Respondents indicated moving forward a decrease in in-person courses with 62% and increase in online courses at 31%. Prior to March 2020, 100% specified that all laboratory courses were offered via in-person settings. Following March 2020, 61% in-person, 31% hybrid, and 8% offered online laboratory courses. All (100%) responded that laboratory courses would return to be offered in-person after the pandemic. All (100%) of program directors responded that they did not lose faculty members directly due to the pandemic (Core 2). Professional involvement (Core 3) remained relatively unchanged with slight shifts after March 2020. Changes to institutional support (Core 4) were identified with 54% of budgets remaining the same, 31% decreasing funding, and only 8% of programs experiencing an increase in support or were not sure (8%). Post-questionnaire interviews revealed overarching themes including: Impact of the Global Pandemic, Challenges, Faculty and Student Interaction, Professional Involvement, Perceptions of Online Learning, Learning, and Positive Effects. **Conclusion:** Overall, programs experienced impacts to their course offerings (lecture and laboratory) due to the global pandemic. However, most programs returned to pre-pandemic approaches (i.e., in-person coursework). Professional involvement for students and faculty was not significantly impacted; however, institutional support was reported to have increased or decreased for almost 39% of the programs. Themes identified focused on students receiving the training and education needed for degree completion (education, professionalism, available faculty, and resources) and the challenges the pandemic had on faculty and students.

Keywords (Audience): educators, academics, graduate

Keywords (Domain): grounded theory, mixed methods, education research, forensic science education

Keywords (Pedagogy): synchronous, asynchronous, traditional, hybrid, on-line

Key Words (Topics): grounded theory in education, forensic education, educational standards, global pandemic

Introduction

Standardization is used to ensure consistency or uniformity and reduce variability within a given field. Published research on forensic education effectiveness and the role standardization plays is limited (1–6). When academic programs choose to meet educational standards and be subject to oversight through accreditation, it helps to ensure that students receive a minimum level of education to reach competency within a given degree program. Evaluating how forensic programs met select Forensic Science Education Programs Accreditation Commission's (FEPAC) standards while impacted by a public health crisis may help to understand its impact, both negative and positive, to pedagogies used by these forensic programs (7).

To evaluate how the targeted accredited programs met FEPAC standards before, during and, where applicable, after a global pandemic, an explanatory sequential mixed methods design was used (8). This design employs two distinct phases, starting with collection and analysis of quantitative data, followed by collection and analysis of data which is qualitative in nature to further expand/explain the results of the quantitative analysis (8). Explanatory sequential mixed methods design has been employed in educational research (9–15). This work utilized grounded theory, which is a data driven approach to guide information collection and analysis. Grounded theory has been used in qualitative research for over sixty years and in many subject areas. It has allowed researchers to “ground” their theory in data that is systematically gathered, sampled, coded, categorized, and analyzed. Within STEM education, programs focused on forensic science may benefit from grounded theory mixed methods research that assesses program design, content delivery, student experiences, faculty demographics, and allocated resources. With Glaser and Strauss's grounded theory, the focus of analysis is determined through the research process (16). Charmaz, Thornberg and other researchers have explored grounded theory and note that it can aid in the development of strategies for theoretical analyses; in the generation of new concepts; contribute to the larger body of scientific knowledge; as well as help to guide policy development and practices (17–20).

The purpose of this study was to evaluate FEPAC accredited masters' programs and how accreditation standards were met with a focus on the effect of a global pandemic in four core areas: 1) providing in-person/traditional, distance learning/online/alternative delivery, or hybrid lecture and/or laboratory coursework (Core 1), 2) composition of forensic faculty (Core 2), 3) professional involvement (Core 3), and 4) institutional support (Core 4). These areas were chosen to assess the

impact of a global pandemic on how forensic programs may have adapted to meet the select FEPAC educational standards.

Research Questions

Employing both a grounded theory and mixed methods approach, a questionnaire of targeted FEPAC accredited masters' programs was used to collect data on how programs met the select core areas identified in the standards, followed by qualitative post-questionnaire interviews to further expand on the findings of the first phase of the research project.

As previously noted, the core areas to be assessed include: 1) providing in-person/traditional, distance learning/online/alternative delivery, or hybrid lecture and/or laboratory coursework (Core 1), 2) composition of forensic faculty (Core 2), 3) professional involvement (Core 3), and 4) institutional support (Core 4). It was hypothesized that there would be variability in how programs met each of the select standards. Utilizing a mixed-methods sequential explanatory design, a questionnaire targeted the previously mentioned core areas to gather data and identify variables on meeting educational standards (8). Post-questionnaire interviews were conducted to expand on the findings.

It was also hypothesized that there would be greater variability in select core areas and specifically those related to shifts in how content is delivered to students pre-, during, and post-pandemic. Further, as forensic academic programs reside in both public and privately funded institutions, there may be a variable shift in institutional support which would affect programs and potentially their ability to meet educational standards.

Methods

Utilizing the FEPAC website (<https://www.fepac-edu.org/accredited-universities>), accredited universities (n43) were identified (7). Of these, 32 universities had accredited bachelor's program, 21 accredited masters' programs, with 12 having either both a bachelors/masters, more than one bachelor's, or more than one masters programs at the time in which this study was conducted. For the purposes of this study, the 21 accredited masters' programs were targeted.

Qualtrics (Qualtrics, Provo, UT, USA) was used to collect data on how FEPAC masters' programs met the core areas identified in the standards, followed by qualitative post-survey interviews to further expand on the findings of the first phase of the research project.

Post Questionnaire Interviews Data Analysis

Data collected from the qualitative post-questionnaire interviews were coded and analyzed. Utilizing ATLAS.ti (ATLAS.ti version 22.2.0, Berlin, Germany), which is a computer-assisted qualitative data analysis software (CAQDAS), themes or patterns were identified based on responses to the instrument questions and post-questionnaire interviews. Using CAQDAS, qualitative research can be evaluated using transcription analysis, coding, text interpretation, content analysis, grounded theory methodology and more (21–23). To further explore the data, descriptive statistics were identified to evaluate sample characteristics.

Institutional Review Board Approval

All procedures and materials were approved by Oklahoma State University Institutional Review Board (Stillwater, OK). The solicitation process lasted from April 4th through June 6th, 2022, and included in-person solicitations, email, and phone/video calls to generate interest from the 21 FEPAC accredited masters' programs.

Ethical Considerations

Respondent anonymity was ensured both with the instrument design and in the post-questionnaire interviews. Oklahoma State University, Center for Health Sciences FEPAC accredited Forensic Sciences master's program was not included due the authors' affiliation to the university. The corresponding author was previously associated with an additional FEPAC accredited master's program.

Results and Discussion

Of the 21 FEPAC-accredited forensic science master's programs in which the instrument was sent, 13 (~62%) program directors completed the survey.

Questions for Instrument

1. Prior to March 2020, did the academic program routinely/typically offer distance learning/online/alternative delivery options for required lecture coursework (Core 1)?
 - a. No, all course work was offered in a traditional/in-person classroom.
 - b. Yes, online courses/distance learning/alternative delivery were offered for up to 25% of course work.

- c. Yes, online courses/distance learning/alternative delivery were offered for up to 50% of course work.
- d. Yes, online courses/distance learning/alternative delivery were offered for up to 75% of course work.
- e. Yes, online courses/distance learning/alternative delivery were offered for 100% of course work.

2. After March 2020, through the 2020-2021 academic year, did the academic program offer distance learning/online/alternative delivery options for required lecture coursework (Core 1)?

- a. No, all course work was offered in a traditional/in-person classroom.
- b. Yes, online courses/distance learning/alternative delivery were offered for up to 25% of course work.
- c. Yes, online courses/distance learning/alternative delivery were offered for up to 50% of course work.
- d. Yes, online courses/distance learning/alternative delivery were offered for up to 75% of course work.
- e. Yes, online courses/distance learning/alternative delivery were offered for 100% of course work.

3. Does the academic program plan to continue offering distance learning/online/alternative delivery options for lecture coursework going forward (Core 1)?

- a. No, all course work will be offered in a traditional/in-person classroom.
- b. Yes, online courses/distance learning/alternative delivery will be offered for up to 25% of course work.
- c. Yes, online courses/distance learning/alternative delivery will be offered for up to 50% of course work.
- d. Yes, online courses/distance learning/alternative delivery will be offered for up to 75% of course work.
- e. Yes, online courses/distance learning/alternative delivery will be offered for 100% of course work. 1

4. Prior to March 2020, did the academic program routinely/typically offer distance learning/online/alternative delivery options for laboratory coursework (Core 1)?

- a. No, all course work was offered in a traditional/in-person laboratory setting.
- b. No or Not applicable (laboratory courses were not offered)

c. Yes, a hybrid approach was utilized where any pre-laboratory lecture material was offered in distance learning/online/alternative delivery, however the laboratory exercises were conducted in-person or in a traditional laboratory setting.

d. Yes, online courses/distance learning/alternative delivery were offered for up to 25% of laboratory course work.

e. Yes, online courses/distance learning/alternative delivery were offered for up to 50% of laboratory course work.

f. Yes, online courses/distance learning/alternative delivery were offered for up to 75% of laboratory course work.

g. Yes, online courses/distance learning/alternative delivery were offered for 100% of laboratory course work.

5. After March 2020 through the 2020-2021 academic year, did the academic program offer distance learning/online/alternative delivery options for laboratory coursework (Core 1)?

a. No, all course work was offered in a traditional/in-person laboratory setting.

b. No or Not applicable (laboratory courses are not offered).

c. Yes, a hybrid approach was utilized where any pre-laboratory lecture material was offered in distance learning/online/alternative delivery, however the laboratory exercises were conducted in-person or in a traditional laboratory setting.

d. Yes, online courses/distance learning/alternative delivery were offered for up to 25% of laboratory course work.

e. Yes, online courses/distance learning/alternative delivery were offered for up to 50% of laboratory course work.

f. Yes, online courses/distance learning/alternative delivery were offered for up to 75% of laboratory course work.

g. Yes, online courses/distance learning/alternative delivery were offered for 100% of laboratory course work.

h. Normally offered laboratory coursework was not offered during this time period.

6. Does the academic program plan to continuing to offer distance learning/online/alternative delivery options for laboratory coursework (Core 1)?

a. No, all course work will be offered in a traditional/in-person laboratory setting.

b. No or Not applicable (laboratory courses are not offered).

c. Yes, a hybrid approach will be utilized where any pre-laboratory lecture material was offered in distance learning/online/alternative delivery,

however the laboratory exercises were conducted in-person or in a traditional laboratory setting.

d. Yes, online courses/distance learning/alternative delivery will be offered for up to 25% of laboratory course work.

e. Yes, online courses/distance learning/alternative delivery will be offered for up to 50% of laboratory course work.

f. Yes, online courses/distance learning/alternative delivery will be offered for up to 75% of laboratory course work.

g. Yes, online courses/distance learning/alternative delivery will be offered for 100% of laboratory course work.

7. Did the composition of faculty members of the forensic program change due to the global pandemic (Core 2)? (Select all options that apply)

a. Yes, faculty members of the forensic program voluntarily left their positions.

b. Yes, faculty members of the forensic program non-voluntarily (i.e., reduction in staff, lack of students, etc.) left their positions.

c. No, no change to the composition of the faculty members in the forensic program.

8. Prior to March 2020, how did the program meet the FEPAC requirement for professional involvement during to the global pandemic (Core 3)? (multiple option responses, respondent asked to select all options that apply):

a. Members of local forensic organizations interact directly with the academic program (select all options that apply):

i. provide internships

ii. serve on graduate research committees

iii. teach as adjunct faculty

iv. serve in an advisory role to the program(s)

v. other (text box for open response)

b. Full-time faculty serve on state, city, county, or federal forensic oversight boards.

c. Full-time faculty recruit research committee members/advisors or collaborators from local/national/international forensic laboratories/organizations.

d. Full-time faculty serve within professional organizations directly related to forensic science (i.e., AAFS, NAME, SOFT, IAI, IACT, TIAFT, IAFS, COFSE, Regional Professional Forensic Organizations, etc.).

e. Full-time faculty serve on standards development organizations directly related to forensic science (i.e., OSAC, ASB, ASTM, etc.)

- f. Full-time faculty serve on forensic certification or accreditation boards, committees or as assessors (ABC, ABFT, FEPAC, etc.).
- g. Other (text box for open response).

9. After March 2020 through the 2020-2021 academic year, how did the program meet the FEPAC requirement for professional involvement during to the global pandemic (Core 3)? (multiple option responses, respondent asked to select all options that apply):

- a. Members of local forensic organizations interact directly with the academic program (select all options that apply):
 - i. provide internships
 - ii. serve on graduate research committees
 - iii. teach as adjunct faculty
 - iv. serve in an advisory role to the program(s)
 - v. other (text box for open response)
- b. Full-time faculty serve on state, city, county, or federal forensic oversight boards.
- c. Full-time faculty recruit research committee members/advisors or collaborators from local/national/international forensic laboratories/organizations.
- d. Full-time faculty serve within professional organizations directly related to forensic science (i.e., AAFS, NAME, SOFT, IAI, IACT, TIAFT, IAFS, COFSE, Regional Professional Forensic Organizations, etc.).
- e. Full-time faculty serve on standards development organizations directly related to forensic science (i.e., OSAC, ASB, ASTM, etc.)
- f. Full-time faculty serve on forensic certification or accreditation boards, committees or as assessors (ABC, ABFT, FEPAC, etc.).
- g. Other (text box for open response).

10. Was the institutional support provided to the program changed due to the global pandemic (Core 4)? (multiple option responses, respondent asked to select all options that apply):

- a. Yes, the program budget increased, or supplemental funds were provided by the institution, due to the global pandemic (i.e., increased due to required supplies, social distancing, or other needs of the program to carry out the required course work, etc.).
- b. Yes, the program budget decreased, or typical funds provided by the institution was not allocated, due to the global pandemic (i.e., loss of students and associated tuition, loss of grant funding, etc.).
- c. Yes, additional space was provided to the program to help carry out course work with a

- consideration to public health concerns and social distancing.
- d. No, the program budget, funding, or space was unchanged.
- e. Not Sure.

Core 1-Instument Results

In evaluating how accreditation standards were met with a focus on the effect of a global pandemic in four core areas, as previously noted, Core 1 focused on how educational content was provided to students. This included in-person/traditional, distance learning/online/alternative delivery, or hybrid lecture and/or laboratory coursework (Core 1). Prior to March 2020, of the programs that responded to the survey, labeled as Question (Q) 1, Core 1, ~77% of programs offered traditional/in-person classroom-based education with only 23% offering online courses/distance learning/alternative delivery were offered for up to 25% of course work (**FIGURE 1**). No program offered non-traditional coursework for more than 25% of their program coursework.

After March 2020, through the 2020-2021 academic year, which was at the height of the global pandemic, only one program (~8%) offered all lecture course work in-person. **FIGURE 1** shows the responses for what percentages of courses were offered online or other alternative delivery format as well as a comparison with pre-pandemic offerings (Qs.1-2, Core 1).

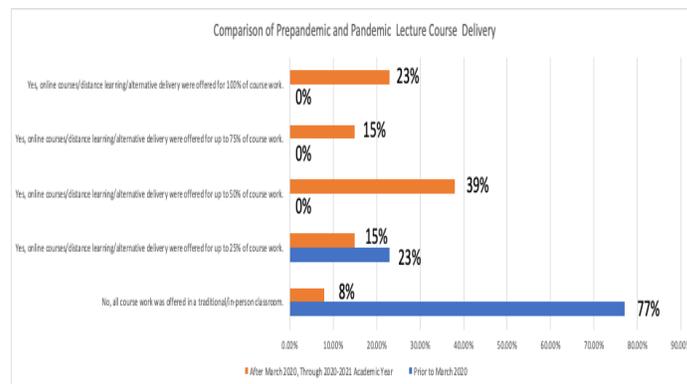


FIGURE 1 FEPAC program responses for what percentages of lecture courses were offered online or another alternative delivery formats after March 2020, through the 2020-2021 academic year as well as a comparison from pre-pandemic delivery (Qs.1-2, Core 1).

Program directors were asked to determine if the academic program plan to continue offering distance learning/online/alternative delivery options for lecture coursework. The results can be viewed in **FIGURE 2**.

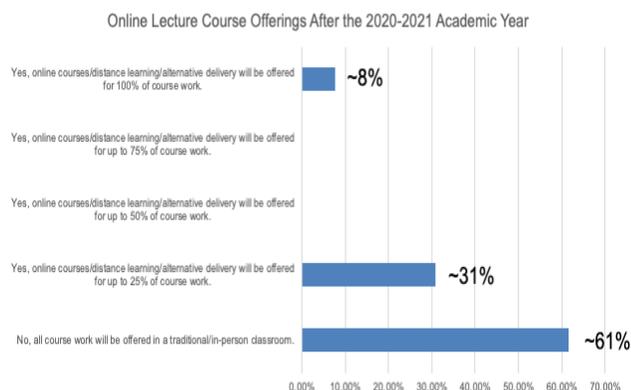


FIGURE 2 FEPAC program responses for what percentages of lecture courses will continue to be offered online or another alternative delivery formats after the 2020-2021 academic year (Q.3, Core 1).

Forensic science and its sub-disciplines are characterized as hands-on careers, therefore academic programs offer laboratory courses focused on providing the knowledge, skills, and abilities needed to perform these roles. Program directors were asked if prior to March 2020 if the FEPAC-accredited academic program routinely offered distance learning/online/alternative delivery options for laboratory coursework (Q. 4, Core 1). All program directors (100%) specified that all laboratory courses were offered in a traditional/in-person laboratory setting.

To prevent the spread of disease, universities and colleges were faced with determining how many individuals could safely be in one confined space and reduce the risk of exposure. Laboratory courses which require adequate space to perform hands-on activities while still maintaining safe distances can be very challenging to hold at the needed enrollment capacities to accommodate the students and ensure they meet the program as well as FEPAC requirements. Therefore, program directors were asked if after March 2020 through the 2020-2021 academic year, if the academic program offered distance learning/online/alternative delivery options for laboratory coursework (Q.5, Core 1). The results can be viewed in **FIGURE 3**.

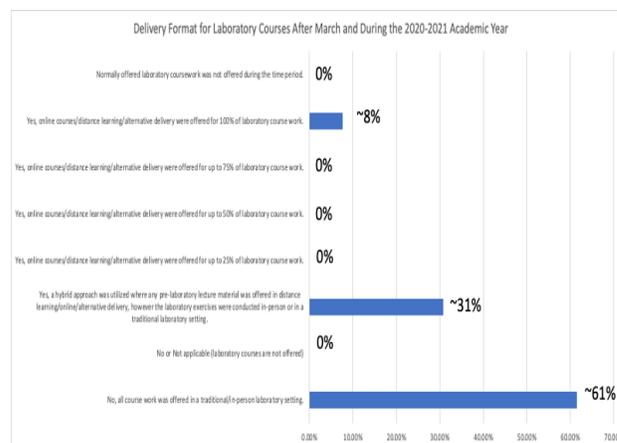


FIGURE 3 FEPAC program responses for what percentages of laboratory courses were offered in-person, online/alternative delivery, or in a hybrid format after March 2022 and during the 2020-2021 academic year (Q.5, Core 1).

Program directors were asked if their academic program plans to continue to offer distance learning/online/alternative delivery options for laboratory coursework (Q. 6, Core 1). All (100%) responded that their programs would only offer traditional/in-person laboratory courses.

Core 2-Instument Results

To better understand the impact of the global pandemic on staffing, Core 2 evaluated the composition of forensic faculty and if those programs lost faculty members (Q7, Core 2). All (100%) of program directors responded that they did not lose faculty members directly due to the pandemic.

Core 3-Instument Results

To understand how academic programs, faculty, and students, achieved the FEPAC standard for professional involvement, program directors were provided a list of activities that faculty members and students may have been involved in (Q.8, Core 3, **FIGURE 4**). Respondents were also provided an option to share other activities. It was noted that faculty were engaged in professional initiatives including grant reviewers, journal editorial boards, and the Innocence Project.

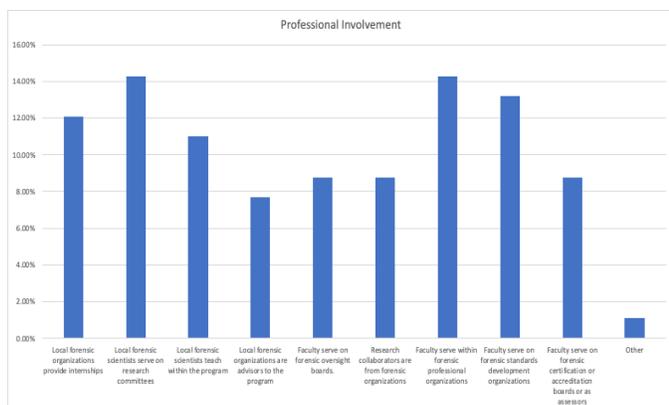


FIGURE 4 FEPAC program responses to how faculty within the program and students met the FEPAC standard for professional involvement (Q.8, Core 3).

At the height of the pandemic and through the following school year (March 2020 through 2020-2021 academic year) with the limitations in travel and in-person meetings, program directors were asked about their program’s professional involvement (Q.9, Core 3), questions on how the global pandemic affected the program and their student’s ability for professional engagement if at all, were asked (FIGURE 5).

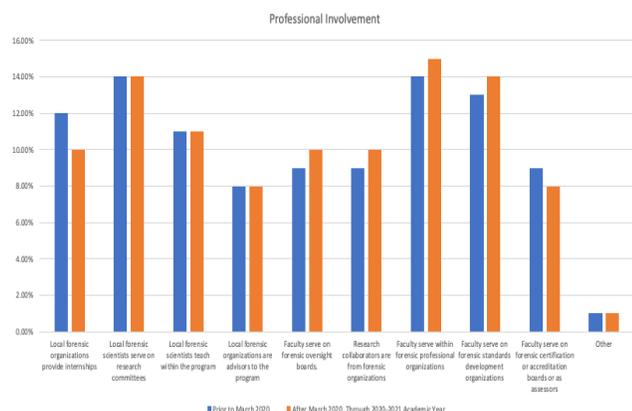


FIGURE 5 FEPAC program responses to how the global pandemic affected the program and their student’s ability for professional engagement after March 2020 through 2020-2021 academic year (Q.9, Core 3) as well as comparison from pre-pandemic involvement.

Core 4-Instument Results

The economic effects of the global pandemic are not fully understood, and it may be some years before we fully appreciate the short- and long-term effects, therefore program directors were asked if the program’s budgets

were altered due to the pandemic (FIGURE 6, Q.10, Core 4).

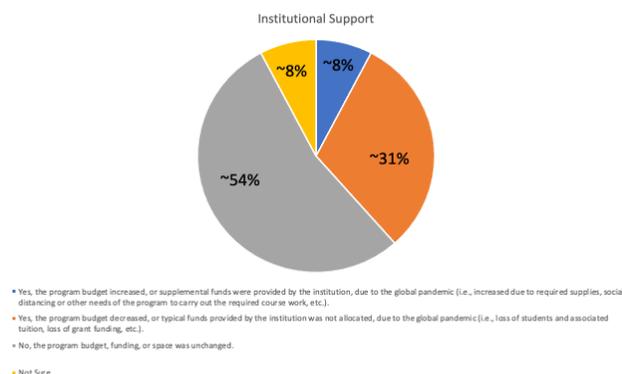


FIGURE 6 FEPAC program responses to how the global pandemic affected the program’s institutional support (Q.10, Core 4).

Forensic academic programs reside in both public and privately funded institutions. Institutional support, either directly or indirectly, may affect programs differently, with some being fully tuition funded and others dependent on grant funding to support student and faculty research. Funding variability and institutional support may also relate to other select core areas assessed such as the composition of forensic program faculty members as well as the ability to meet the standards regarding professional involvement.

Post-Questionnaire Interviews

Following the administration of the instrument to collect the before mentioned data, each response was evaluated for completeness, and post- questionnaire interviews were conducted. These interviews were conducted with program directors. Of the 21 FEPAC accredited forensic science masters programs, 7 (33%) program directors took part in the one-on-one interviews. Conducting this qualitative data collection helped in the interpretation of participant responses to the instrument, as well as explain or describe variations in responses to the same question. The qualitative post-questionnaire interviews were evaluated, transcribed, and then coded.

Follow-Up Questions and Associated Core Areas

Core 1

1. Can you provide additional details as to why core courses were not offered by distance learning prior to March 2020?
2. Are courses outside the program offered by distance learning/online/alternative delivery options?

3. Does the program or university have the technology to support distance learning/online/alternative delivery options?
3. Is distance learning/online/alternative delivery options as effective as in-person teaching?
4. Did students find distance learning/online/alternative delivery options as effective as in-person teaching?
5. Did the program consider offering distance learning/online/alternative delivery options for laboratory courses? If so, what were some of the barriers to offering distance learning/online/alternative delivery options for laboratory courses?

Core 2

1. If faculty members left voluntarily, did they do so to continue teaching at another institution or take on a position in a forensic organization?
2. If faculty member(s) left non-voluntarily, did they do so due to faculty cuts or lack of funding?
3. If faculty members left voluntarily, did they do so due to medical issues related to the global pandemic?

Core 3

1. Did program requirements change to meet the FEPAC professional involvement requirement?
2. Did any students take part in an on-line or remote internship program?
3. Was there any change to how local forensic organizations interacted with the forensic program during the global pandemic?
4. Were there any benefits seen during or due to the global pandemic? For example, were members of forensic organizations in more of a position to interact with the academic program as they had more available time to do so? Or did faculty members have an opportunity to work with collaborators they normally would not have the opportunity to do so, such as those outside of the United States?

Core 4

1. If you answered yes to a program budget increase or decrease can you elaborate on why this occurred?
2. If additional space was offered to carry out teaching and/or research objectives due to the global pandemic, did this additional space remain with the program after capacity restrictions were removed-if they have been lifted?
3. If the program budget was not affected, do you believe that the academic program suffered due to the global pandemic and meeting the FEPAC standard for institutional support?

Post Questionnaire Interviews Results and Discussion Codes Identified

Upon transcribing the interviews, these were imported into ATLAS.ti along with the video recordings. Transcripts were reviewed for accuracy. After completion of coding, the frequency of each code was evaluated. If a code was not used, it was deleted. Codes with only one or two occurrences were evaluated and merged, if possible, with a similar code resulting in an initial 40 codes (n40). All codes were further evaluated to ensure uniqueness, merged, if necessary, with a result of 33 (n33) final codes for data analysis as can be seen in **FIGURE 7**.

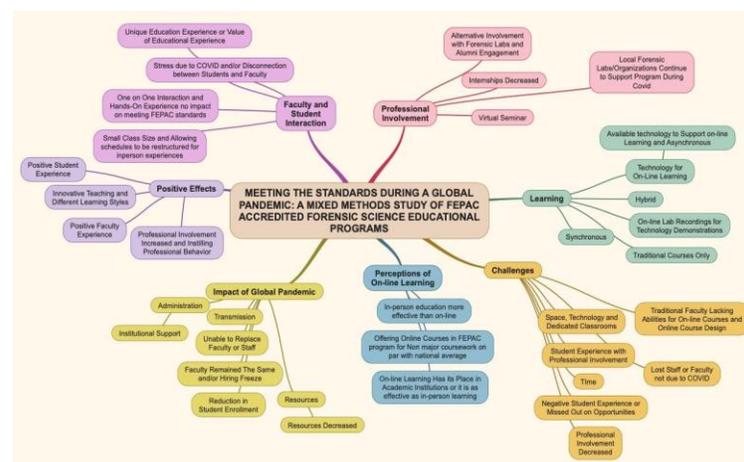


FIGURE 7 Finalized codes for data analysis. (Created using SimpleMind, Version 1.32.0).

Codes were evaluated for overarching themes and included: Impact of the Global Pandemic, Challenges, Faculty and Student Interaction, Professional Involvement, Learning, Perceptions of On-Line Learning, and Positive Effects. Subcategories within these themes are described and occurrences. It should be noted that themes are connected not only under overarching topics, but also between main ideas. **FIGURE 8** demonstrates the Code Cloud with the size of each word indicating the frequency of occurrences, i.e., increasing text size representing increase in frequency and vice versa. The following sections outline the total number of occurrences of the over-arching theme, as well as individual instances of subtopics.



FIGURE 8 Code cloud indicating frequency of codes with the increasing text size representing increase in occurrences (Created using ATLAS.ti, Version 22.2.0).

Impact of the Global Pandemic

As the focus of this research is the impact of the global pandemic, or COVID-19 (which was the term most often used in the interview process), had on meeting select FEPAC standards, it is not surprising that the topic would be discussed during the interview process. There was a total of 38 occurrences on the impact of the global pandemic, with transmission of COVID-19 and steps taken to prevent the spread of the virus communicated five (15%) times. There were six (18%) instances regarding that the faculty remained the same or that a hiring freeze was put in place. Three (9%) instances where the reduction in student enrollment occurred. University administration and institutional support was discussed in seven (21%) occurrences, with resources, including reduction in resources, discussed 17 (52%) times, by far the most often noted within the impact of the global pandemic theme.

Challenges

There were 77 occurrences where codes involving challenges were discussed. It is not surprising that challenges with space, technology, and dedicated classrooms for the academic programs were noted and occurred 11 (33%) times. Traditional faculty lacking abilities to carry out on-line courses and on-line course design-10 (30%), student experience with professional involvement-6 (18%), lost staff or faculty not due to COVID-6 (18%), available time-17 (52%), professional involvement decreased-8 (24%), and the most often occurring topics being negative student experience or missed opportunities with 19 (58%) instances.

Faculty and Student Interaction

A key component of successful graduate education is faculty and student interaction. There were 56 instances where codes involving these interactions were discussed. The occurrences included the programs’ ability to provide unique education experiences or value of educational experience 9 (27%), stress due to COVID and/or disconnection between students and faculty 15 (45%), as well as importance of small class size to allow schedules to be restructured for in person experiences 10 (30%). There were 22 (67%) occurrences that included topics regarding one-on-one interactions, hands-on experience, as well as how these factors had no impact on meeting FEPAC standards.

Professional Involvement

As previously noted, to understand how academic programs, faculty, and students achieved the FEPAC standard for professional involvement, program directors were provided a list of activities that faculty members and students may have been involved in. There were 34 occurrences of codes involving professional involvement. During the interview process, topics were identified including alternative involvement with forensic labs and alumni engagement 15 (45%), decrease in internships 7 (21%), local forensic labs/organizations continue to support programs during a global pandemic 7 (21%), and virtual seminars 5 (15%).

Learning

As the topic of this research is education, specifically educational standards, it is expected that codes related to learning (51 occurrences) and how courses were offered would be identified including synchronous 7 (21%), traditional/in-person courses only offered 8 (24%), and hybrid 12 (36%) approaches. Offering on-line laboratory recordings for technology demonstrations had 7 (21%) occurrences. When asked if the programs had technology for on-line learning (available technology to support on-line learning or provide asynchronous education) there were 17 (52%) instances that the programs did feel they had it available.

Perceptions of On-Line Learning

To gather more details on perceptions of on-line learning (43 occurrences) and if those may have impacted the approach taken to deliver course content prior to, during and after the height of the global pandemic questions were asked to derive more details. It was noted in 18 (55%) occurrences that program directors of FEPAC accredited master’s programs that in-person education is more effective than on-line courses. When asked, offering

online courses in FEPAC program occurred for non-major coursework and when noted, that they felt their institutions were on par with national average 11 (33%) for on-line learning. Finally, in 14 (42%) occurrences, program directors felt that on-line learning had a place in academic institutions, or it was viewed as effective as in-person learning for certain coursework or academic disciplines.

In addition to available technology or faculty trained in on-line pedagogies, there are other possible reasons for not offering courses in non-traditional formats. As noted, the beliefs that in-person education is more effective or reluctance for institutions to adopt on-line learning due to loss of funding that comes with traditional programs (i.e., housing/food/tuition dollars) may also be reasons to consider.

Positive Effects

Challenges, stress, disconnection between students and faculty, and other negative effects were experienced during and continue to be felt after the height of the global pandemic, however there were unanticipated positive effects (57 occurrences) including 25 (76%) instances of positive student experiences, 11 (33%) of innovative teaching and accommodating different learning styles, 10 (30%) of positive faculty experience, and 11 (33%) of professional involvement increases and instilling professional behavior.

Conferences, seminars and/or other forms of virtual continuing education were noted in professional involvement and behavior where students and faculty could attend and/or participate without the burden of travel costs. Virtual seminars and engaging alumni were another added benefit where programs began to recruit seminar presenters from outside their geographical location and invite graduates of the program to these events.

Limitations

As previously mentioned there may be variability in how accredited forensic programs meet the FEPAC standards. Currently, there is only one accreditation program that is specific to forensic science education in the United States with only 32 accredited forensic programs, and only 21 accredited masters' programs. Per the National Center for Education Statistics (2019) there are approximately 3,000 four-year colleges in the United States (24). Therefore, the number of accredited forensic education programs is an extremely small number (~1%) relative to the number of total programs. Further, although forensic organizations may require that applicants' degrees are obtained from accredited universities/colleges, they may not specify that they are

FEPAC accredited. Through the Council of Forensic Science Educators (COFSE), committee members have captured forensic science programs in the United States (as of February 2019) and provided this to COFSE members. This list includes over 350 bachelors and masters' programs related to forensic science education (25). Therefore, FEPAC accredited programs only account for ~9% of all forensic related educational programs.

Conclusion

Overall FEPAC accredited programs experienced impacts to their course offerings (lecture and laboratory) due to the global pandemic. For lecture-based courses, there was a shift from traditional to on-line courses, even following the height of the pandemic. However, all programs returned to pre-pandemic approaches such as offering traditional in-person laboratory-based courses. Professional involvement for students and faculty was not significantly impacted and in some cases were positively affected. However, institutional support was reported to have increased or decreased for almost 39% of the programs. Themes identified focused on students receiving the training and education needed for degree completion (education, professionalism, available faculty, and resources) and the challenges, such as missed opportunities, the pandemic had on faculty and students.

Acknowledgements

The corresponding author would like to express her gratitude to Dr. Bryan Jones for his review of this work at each stage.

References

1. Botch-Jones S, Thrasher R, Miller B, Hess J, Wagner J. A review of existing forensic laboratory education research and needs assessment. *J Forensic Sci Educ* 2021;3(1).
2. Tregar KL, Proni G. A review of forensic science higher education programs in the United States: Bachelor's and master's degrees. *J Forensic Sci* 2010;55(6):1488-93.
3. Siegel J. The appropriate educational background for entry level forensic scientists: a survey of practitioners. *J Forensic Sci* 1988;33(4):1065-8.
4. Higgins KM, Selavka CM. Do forensic science graduate programs fulfill the needs of the forensic science community? *J Forensic Sci* 1988;33(4):1015-21.
5. Furton KG, Hsu YL, Cole MD. What educational

- background do crime laboratory directors require from applicants? *J Forensic Sci* 1999;44(1):128–32.
6. Quarino L, Brettell TA. Current Issues in Forensic Science Higher Education. *Anal Bioanal Chem* 2009;394:1987–93.
 7. FEPAC. Forensic Science Education Program Accreditation Standards [Internet]. American Academy of Forensic Sciences; 2020. p. 1–18. Available from: [https://www.fepac-edu.org/sites/default/files/FEPAC Standards 02152020.pdf](https://www.fepac-edu.org/sites/default/files/FEPAC%20Standards%202152020.pdf).
 8. Ivankova N, Creswell J, methods SS-F, 2006 undefined. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice Citations at UCLA COLLEGE SERIALS/YRL on. *journals.sagepub.com*. 2009;18(1).
 9. Bowen P, Rose R, Pilkington A. Mixed methods-theory and practice. Sequential explanatory approach. *International Journal of Quantitative and Qualitative Research Methods*. 2017;5.
 10. Bullock EP. An explanatory sequential mixed methods study of the school leaders' role in students' mathematics achievement through the lens of complexity theory. *ProQuest Diss Theses* 2017.
 11. Kustandi C, Fadhillah DN, Situmorang R, Prawiradilaga DS, Hartati S. VR use in online learning for higher education in Indonesia. *Int J Interact Mob Technol* 2020;14(1).
 12. Zetriuslita Z, Wahyudin W, Jarnawi J. Mathematical critical thinking and curiosity attitude in problem based learning and cognitive conflict strategy: a study in a number theory course. *Int Educ Stud* 2017;10(7).
 13. Lan M, Hew KF. Examining learning engagement in MOOCs: a self-determination theoretical perspective using mixed method. *Int J Educ Technol High Educ*. 2020;17(1).
 14. Abraham J. Segregation in basic school in Haiti, reflecting the social relations of inequality. *Univers J Educ Res* 2019;7(8).
 15. Thornberg R, Forsberg C, Chiriac EH, Bjereld Y. Teacher–student relationship quality and student engagement: a sequential explanatory mixed-methods study. *Res Pap Educ* 2020;37(6).
 16. Glaser BG, Strauss AL. The discovery of grounded theory; strategies for qualitative research [Internet]. Grounded theory. Chicago: Aldine Pub. Co.; 1967. p. x, 271 p. (Observations). Available from: <file://catalog.hathitrust.org/Record/000003666>.
 17. Charmaz K, Thornberg R. The pursuit of quality in grounded theory. *Qual Res Psychol* 2020;18(3):305-27.
 18. Birks M, Hoare K, Mills J. Grounded Theory: The FAQs. *Int J Qual Methods*. 2019;18:1-7.
 19. Rieger KL. Discriminating among grounded theory approaches. *Nurs Inq* 2019;26(1).
 20. Morgan DL. Pragmatism as a basis for grounded theory. *Qual Rep*. 2020;25(1).
 21. Leech NL, Onwuegbuzie AJ. Beyond constant comparison qualitative data analysis: using NVivo. *Sch Psychol Q*. 2011;26(1).
 22. Leitch J, Oktay J, Meehan B. A dual instructional model for computer-assisted qualitative data analysis software integrating faculty member and specialized instructor: Implementation, reflections, and recommendations. *Qual Soc Work* 2016;15(3).
 23. Dalkin S, Forster N, Hodgson P, Lhussier M, Carr SM. Using computer assisted qualitative data analysis software (CAQDAS; NVivo) to assist in the complex process of realist theory generation, refinement and testing. *Int J Soc Res Methodol* 2021;24(1).
 24. National Center for Education Statistics. National Center for Education Statistics. *Digest of Education Statistics*. 2020.
 25. COFSE (Council of Forensic Science Educators). www.cofse.org.